Aerospace Technical Services
Wildfire Mitigation Project Weekly Update
March 19, 2024

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Mitigation 2

Early Fault Detection (EFD)

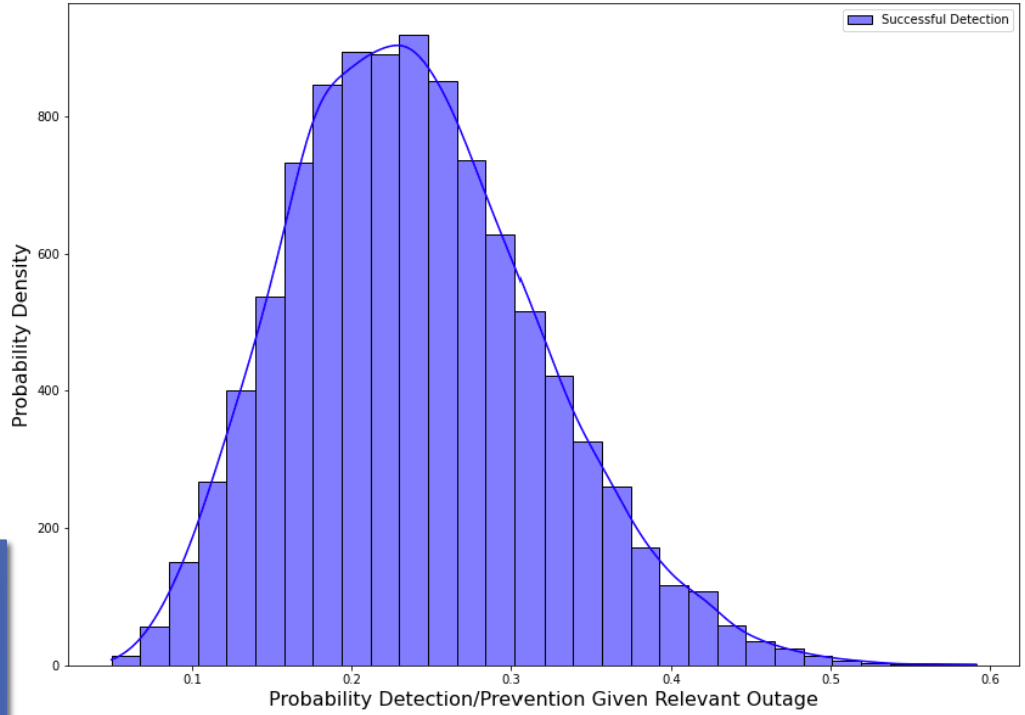
Updated Data Had Little Effect On EFD Results

- Previously, ATS defined the distribution which represents $P(relevant\ outage|any\ outage\ occurs)$ using any distribution outages for a circuit
- Now, we filter to only include overhead outages in HFTD 2/3

However, the EFD ME results change only slightly

Updated:
Expected Probability of Relevant Detection = 24%

- Resulting distribution after updating: $Beta(7,22)$
- Recall: $E[\alpha, \beta] = \frac{\alpha}{\alpha+\beta}$
  - Therefore, the expected probability that EFD will detect/prevent a relevant outage given that a relevant outage occurs is 24%



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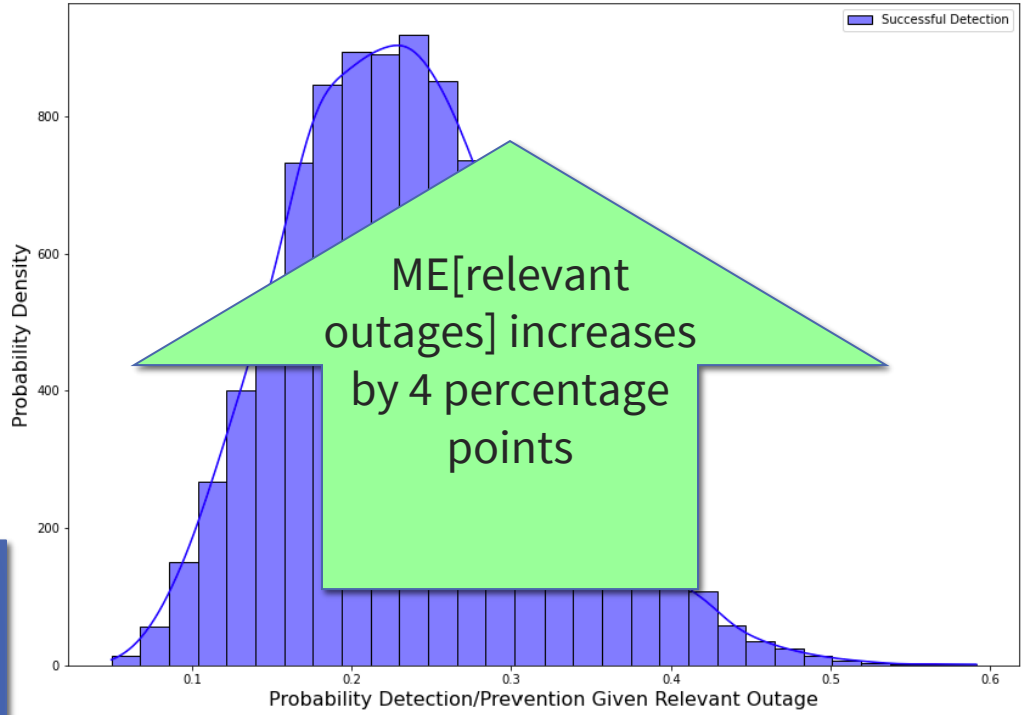
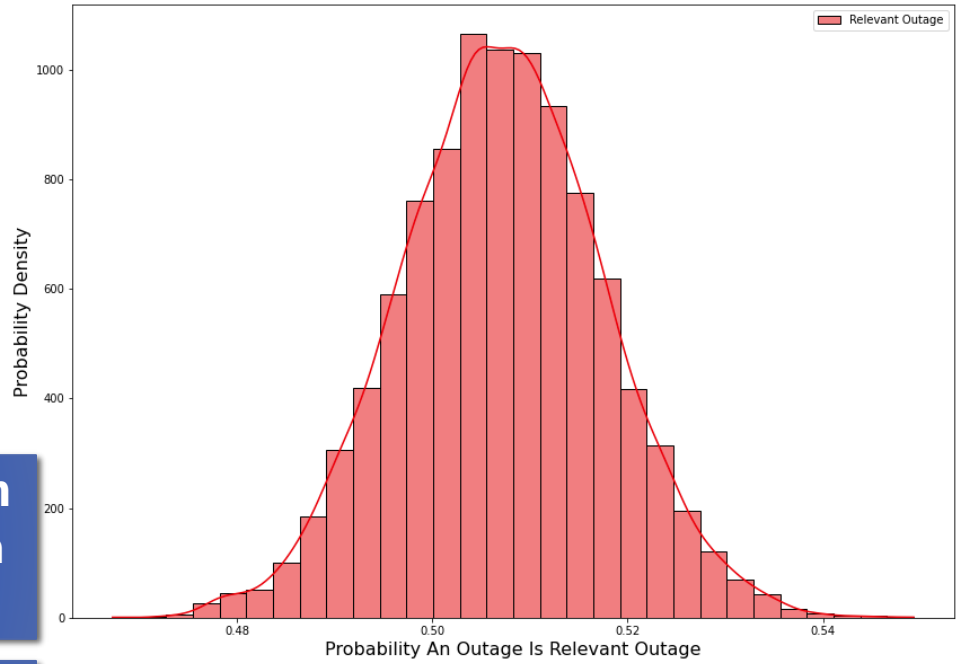


Updated:
Expected Probability of Outage Being Relevant = 51%

- Resulting distribution after updating: $Beta(1182,1150)$
- Recall: $E[\alpha,\beta] = \frac{\alpha}{\alpha+\beta}$
  - Therefore, the expected probability that a relevant outage occurs given an outage occurs is 50.7%



ATS methods result in a **full distribution** around the expected value rather than a point estimate

ATS will use this distribution to compute joint probability distribution

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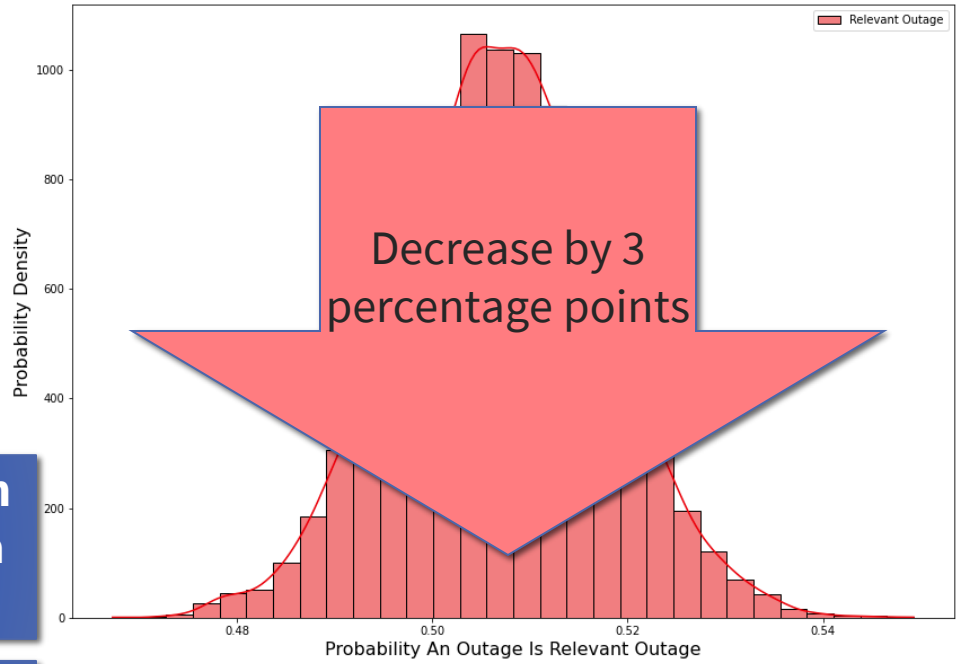

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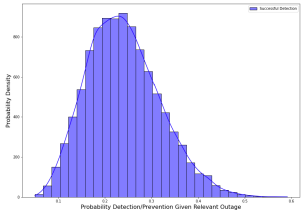
ME[all outages] is the ME Over All Possible Outages

- 

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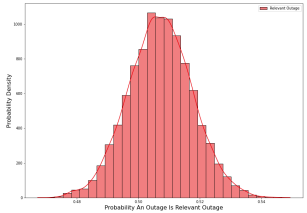
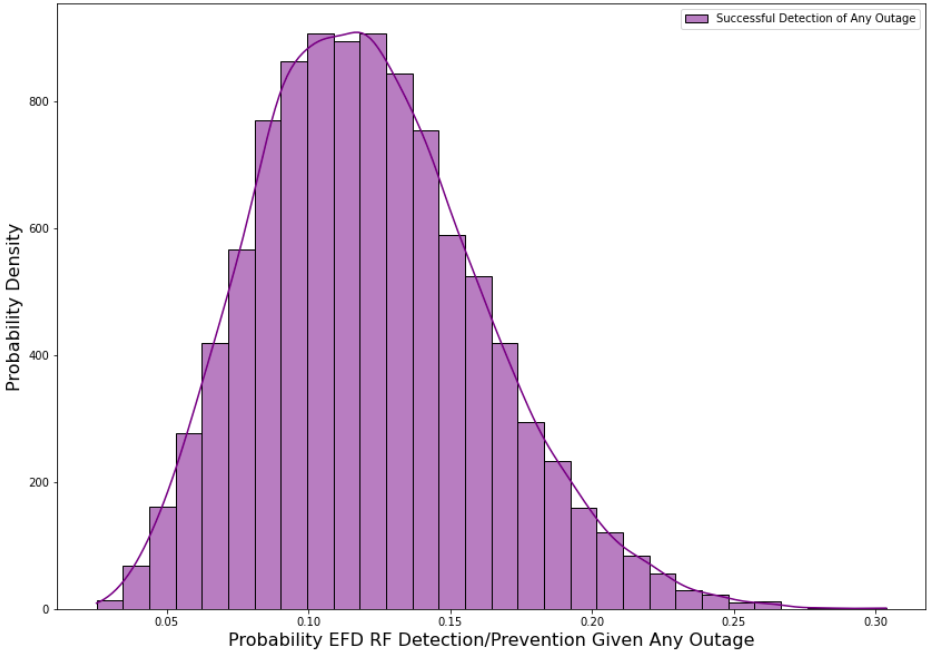


$\vdash$

- To define the joint distribution, we use element-wise multiplication on the two $10{,}000 \times 1$ Monte Carlo sampled matrices
- Joint distribution can be described as $\mu = 0.122, \sigma = 0.040$
- Expected probability EFD detects/prevents an outage for any outage is 12%



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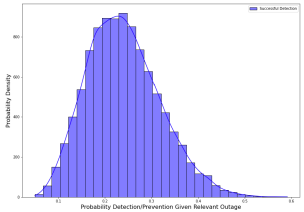
- 

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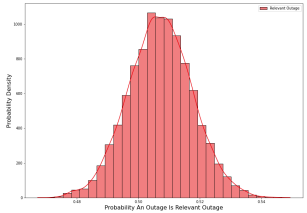

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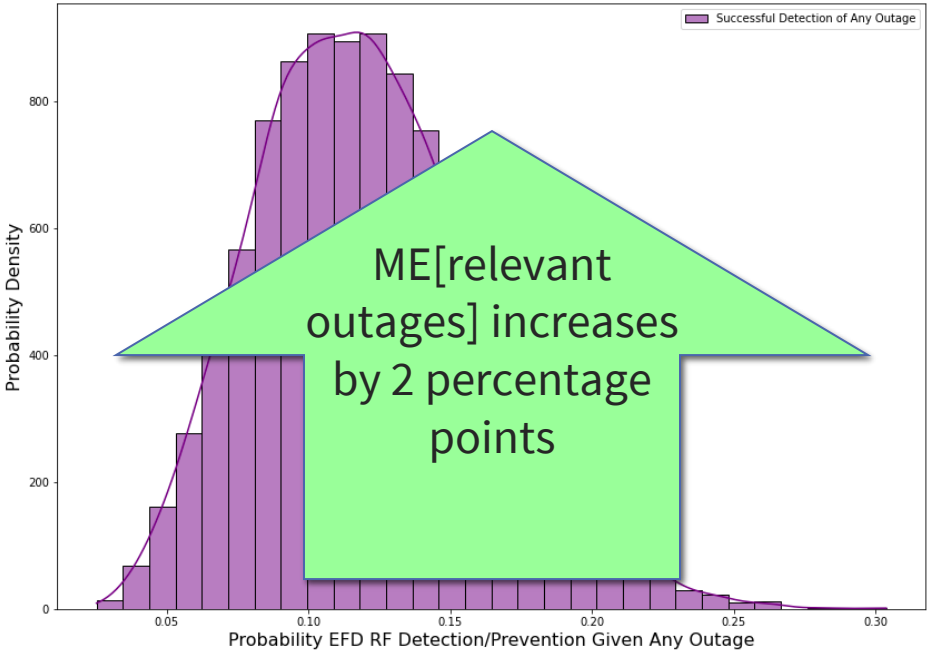

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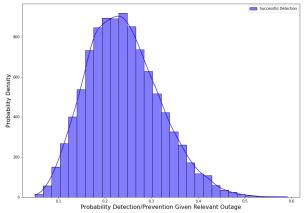
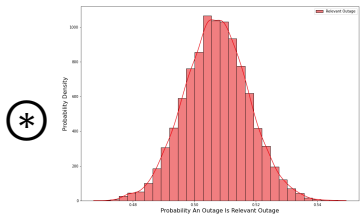
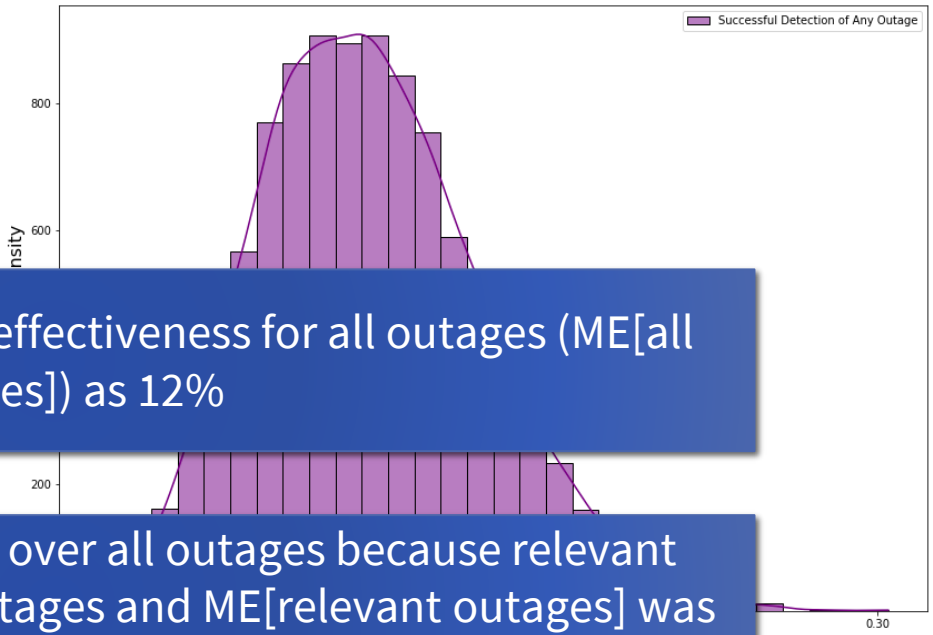
- 





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- Joint distribution can be described as μ…
- Expe… dete… outage is 12%

ATS identifies the mitigation effectiveness for all outages (ME[all outages]) as 12%

A small ME value is expected over all outages because relevant outages are a fraction of all outages and ME[relevant outages] was low

Summary of EFD Mitigation Effectiveness Analysis

- ATS assesses EFD ME using EFD installation data, IND.T detection data, iPredict detection data, and relevant outage data
- We use Bayesian inference and Beta-binomial conjugacy to define marginal and joint distributions
- ATS finds the ME[all outages] for EFD to be greater than that of FCP because it can detect a larger number of total outages despite a lower ME[relevant outages]
- We perform sensitivity analysis to show how both ME[relevant outages] and ME[all outages] may change with more data

Bottom line ME values:

ME[relevant outages] = 24% +4%

ME[all outages] = 12% +2%